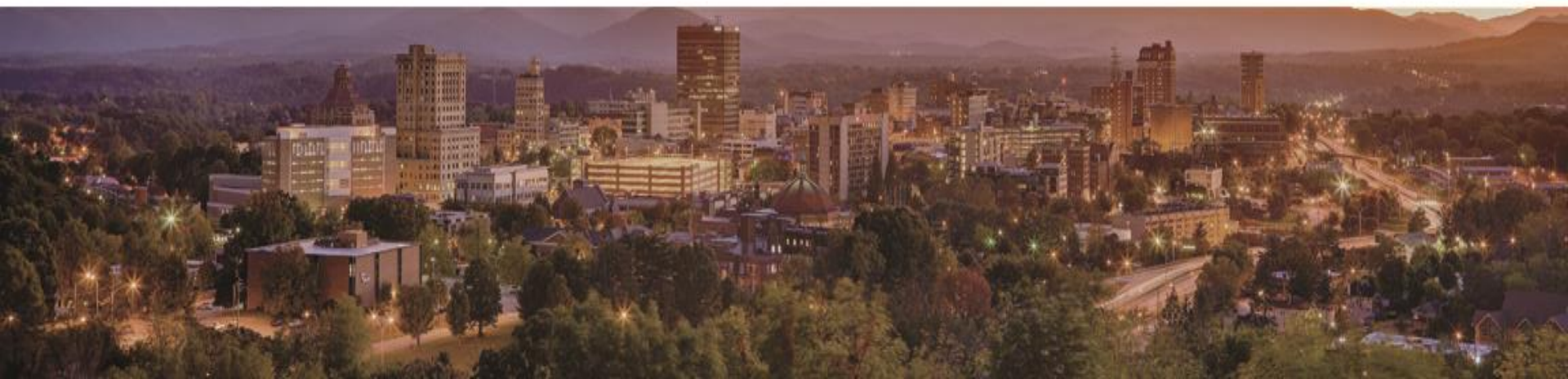




May 3, 2017 ESI

## Utility Bills: Finding Buried Treasure

*Department of Environmental Quality*



# *Utility Bills 101*

## Typical Electric Bills Regulated Utilities

- Energy & Demand in kWh; kW
- Billed, Actual, Contract, Excess Demand, Coincident Peak
- Time of Use; On Peak, Off Peak, Seasonal Date & Times
- Power Factor; kVA; Correction strategies
- Hidden costs in rates (Riders); find your rate schedules; OPTions
- Interval Data; how to get it, what it can do for you

## Nat Gas Billing:

- Read your bills, contracts; seasonal strategies
- Purchasing Contract Nat. Gas

## Water and Sewer

- Water billing; units, gal., 1,000 gal, CCF, sewer, stormwater fees

## Case Studies

- Municipal Electric Utility: Power Factor Penalty due to meter error
- Negative Power Factor Penalty due to Overcorrection
- Demand Response: Contract Peak Load Reduction Not Applicable
- Demand Response: Shared Savings with third party not necessary
- Rate Savings Opportunities working with Utility companies, OPTions for credits
- Third Party Billing Services: Process bills and get data
- Ratchet reset due to equipment failure
- New construction ratchet transformer changeout



# *Difference in Energy and Demand*

**Electricity** is like water – it flows like water in a pipe.

- Electric “Current” is flow of electrons in wires



**Demand** – How **fast** is the Flow Rate?  
Gallons per minute?(GPM).

- How many Watts turned on?
- Typically measured in kilowatts (**kW**).



**Energy** – How many **gallons** used over a period of time?

- How many Watts x run hours?
- Typically measured in kilowatt-hours(**kWh**)



# *Electric Bill Energy Costs*

**Energy** measured or billed in **kWh** (typically)  
Also called **Usage** or **Consumption**

**Energy = Work** (to run a motor, light a bulb) over time

- How much electric **Work** did you do in a month?
- How many **kWh** did you consume?

1. **Energy = kW x hours = kWh**  
**(kilowatt-hour)**

**OR**

2. **Energy = KVA x hours = KVAh**  
**(kilovolt-amp-hour)**



# *KW, KVA = “Demand” for Power* *Electric “Power” Company*

**Power = Watts = Volts x Amps = VA = W**

Power = Work/time = Energy per hour

How fast is energy flowing? At what rate?

1000 W microwave cooks faster than 500 W.

Measured in 15 or 30 minute intervals,  
averaged over time, depends on meter

Think: How big (how many watts) is your light bulb?



1. Billed as: **Demand kW** (kilowatt) = **1,000 W**

1000 W = 10 x 100 W light bulbs = 1 kW

**OR**

2. Billed as **Demand KVA** (kilovolt-amp) = **1,000 x VA**

**KVA includes Power Factor Penalty! (more to come)**



# *Typical Electric Bill*

## **Monthly Facilities Charge**

- \$12 to \$500 (based on rate “class”)
- Fixed monthly fee to provide electric service
- Based on size of equipment, transformers, 1 or 3 phases

## **Energy Charge**

- kWh x \$ per kWh (energy rate)
- ~ \$ 0.10 per kWh
- Rate may vary based on Time of Day, Month

## **Demand Cost**

- kW x \$ per kW (demand rate)
- ~ \$10 per kW



# *Typical Electric Rates*

## *Rate Classifications*

### **General Service (GS) Rates**

- Rate “class” based on annual Peak Demand kW
  - How much load or power needed
  - More power requires more costly equipment, i.e., larger transformers
- Small (less than 30 kW)
- Medium (30 kW to 1000 kW)
- Large (over 1000 kW)
- Commercial
- Industrial
- One phase or three phase power
- Brackets (size by kW) vary by utility company



# *Typical LGS (Large General Service)*

## **MONTHLY RATE**

**I. Basic Customer Charge: \$154.85**

**II. kW Demand Charge: (Stepped)**

**\$11.23 per kW for the first 5,000 kW**

**of Billing Demand**

**\$10.26 per kW for the next 5,000 kW**

**of Billing Demand**

**\$ 9.29 per kW for all over 10,000 kW**

**of Billing Demand**

**III. kWh Energy Charge: 5.575¢ per kWh**





# *Voltage Distribution Industrial Rates*

## **Low Voltage is 480V; 3 phase power**

- Most expensive
- Utility provides & maintains step-down transformers

## **Distribution Service 2 kV to 50 kV (Varies)**

- Customer usually supplies and maintains transformers

## **Transmission Service greater than 50 kV (Varies)**

- Least expensive
- Customer supplies and maintains transformers

## **Where is meter located?**

- If meter on load side of customer transformer,  
rate may include transformer loss calculation



# *Types of Billing Demand*

## **CONTRACT DEMAND**

- The KW of demand specified in the *“Service Agreement”* (Where?)
- Estimated from Design Peak Load when new service is established.

## **ACTUAL DEMAND**

- 15 or 30 min. average KW (as measured or calculated by demand meter)
- Peak Demand = maximum measured in a month

## **BILLED DEMAND- See Rate or Tariff Definition (next page!)**

- May not be ACTUAL
- “Ratchet”



# *Billing Demand*

“The **Billing Demand** shall be the **maximum kW** registered or computed, by or from Company's metering facilities, during any **15-minute interval** within the current billing month.

**However**, the Billing Demand **shall not be less than the greater of:**

- (1) **80%** of the maximum monthly 15-minute demand during the billing months of **July through October** of the preceding 11 billing months (Summer Peaking)
- (2) **60%** of the maximum monthly 15-minute demand during the billing months of **November through June** of the preceding 11 billing months (Winter Peaking)
- (3) **75%** of the **Contract Demand** until such time as the Billing Demand first equals or exceeds the effective Contract Demand, or
- (4) **1,000 kW.**”

Courtesy Duke Energy Progress LGS Rate

**Billing Demand is your Minimum Demand Billing**



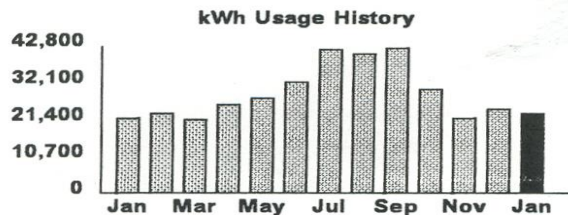
# Find kWh Usage, \$ and KW Demand, \$

00045858 1 AV 0.278 00\*\*AUTO\*\*C004

Customer Name

Address

ASHEVILLE NC 28801-3271



## Customer Bill

page 1 of 2

Account number 9860

Total due \$1,904.39

Current charges past due after Feb 4

Thank you for your payment Jan 2 \$2,113.30

Usage period Dec 18 - Jan 20

This bill was mailed on January 21, 2004

### Usage

Meter number TA3536

Readings: Jan 20 9787

Dec 18 - 9588

Meter constant x 120

kWh usage 23880

Days in period 33 Average kWh per day 724

Actual kW Demand 80.40

### Billing

MGS rate

Basic customer charge

33 Days

Energy charge

23,880 kwh x \$0.05132 1,225.5216

Demand charge

(80% of 132.00 kw (09/03))

105.60 kw x \$4.89000 516.3840

Three phase service charge

9.00

ALS rate

Metal halide light, 160 kwh, 40000 lumens, flood

33 Days

Area lighting

1 Light x \$25.63 25.63

Wood pole charge

1 Pole x \$2.16 2.16

ALS rate

High Pressure Sodium light, 46 kwh, 9500 lumens, flood

33 Days

Area lighting

1 Light x \$11.15 11.15

ALS rate

High Pressure Sodium lights, 109 kwh, 28500 lumens, flood

33 Days

Area lighting

3 Lights x \$15.69 47.07

3% North Carolina sales tax

55.47

Total due \$1,904.39

Please detach here.

Turn over for helpful phone numbers and customer service tips.

PIN:

# *Coincident Peak*

- **Customers of Municipal Power Companies or other utilities who buy wholesale power, or Deregulated utilities (other states)**
- **Coincident peak is your demand kW measured when the hourly IOU system monthly peak occurs**
- **Highest costs for kW during generation company peak demand for the system total as set by their customers**
- **Up to \$35 per kW during coincident peak**
- **Some municipal utilities install peaking generation**
- **Demand-side Management (DSM) programs pay \$**
- **Load shedding, shaving or curtailment**
- **Notification programs when Peak is to occur**
- **Weather dependent; can be winter peak for heat pumps**
- **ERCOT (TX) or PJM (Northeast) deregulated markets have historical data online; typically 4 to 5 pm**
- **Shut down early in summer; work 3am to noon Alabama**



# *Time of Use (TOU) Rates*

**Higher rates during “peak” times**

- **Summer afternoons, Winter mornings**

**Lower rates charged “off-peak” to encourage:**

- **peak shifting (scheduling)**
- **peak shaving (turn some things off)**

**Some utilities have very long duration summer “peaks”**

**6 am to 4 pm; 10 am to 10 pm; 6 am to 12 am**

- **Read the rates and watch for seasonal changes, especially if occurring over the weekend**
- **Need to reset manual timers or digital controls setpoints unless Astronomical Time Clock w/DST**



# *Load Factor*

**What percentage of maximum possible energy (kWh) did you use in a month?**

- **Maximum hours in a month:**

$$24\text{hr} \times 30\text{d} = 720 \text{ hrs per month}$$

- **Max kWh = Monthly Peak Demand (kW) x hrs**
- **500 KW Peak x 720 hours = 36,000 kWhs**
- **If monthly metered usage = 20,000 kWhs**

➔ **Load Factor =  $20,000/36,000 = 0.56$  LF**

**Load Factor less than 40%: one shift operations**

**Load Factor greater than 70%: 3 shifts**

**Electric Utilities prefer higher load factors**

**High LF with 1 shift = opportunity to turn things off**

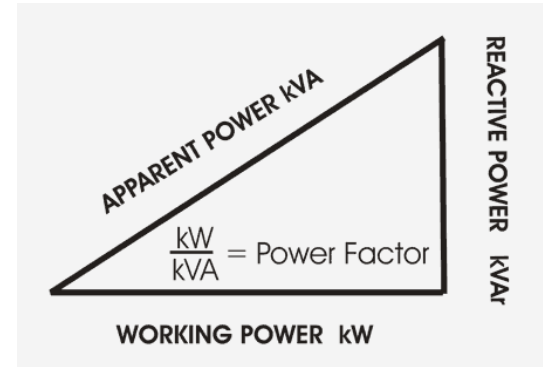


# Power Factor Penalty

- **kVA = Utility delivered power to meter**
- **kW = power used by customer to do work**
- **kVA x Power Factor = kW or PF = kW/kVA**
- **Power Factor = Reactive losses in motors, magnetic windings**
  - Power factor reduces “usable” power
  - Losses measured in KVAR (kilovolt-amps reactive)
  - Electric Resistance heat has PF = 1.0 (No losses)
- **Utilities set PF targets = 80-90% w/penalties if below target**
- **Example: Penalty for PF below 90%; actual PF = 82%**
  - **KW billed = KW actual x 90/actual PF**
  - **KW billed = 200 KW x 90/82 = 220 KW; added 20 KW**

**Do I have a Power Factor Penalty?**

- **If billed in KVA; includes PF penalty built in!**
- **If billed in KW, may have a line item for PF Penalty**
  - **Easiest to spot!**
- **If little or no penalty, don't need PF Correction!**





# *Power Factor Penalties*

## **SAMPLE POWER FACTOR ADJUSTMENT CLAUSE**

**“ When the power factor in the current billing month is less than **85%**, the monthly bill will be increased by a sum equal to \$0.34 multiplied by the difference between the maximum reactive kilovolt-amperes (kVAr) registered by a demand meter suitable for measuring the demands used during a 15-minute interval and 62% of the maximum kW demand registered in the current billing month.”**

**Duke Energy Progress**

- **Penalties usually greatest for municipal power companies who buy wholesale power**
- **Low power factor increases current, heat, maintenance,  $I^2R$  losses**
- **Low power factor means more kVA power required to be generated**

## **Solutions?: Power Factor Correction**

- **Line Capacitors installed by Utilities; request assistance**
- **Stepped Capacitor Banks correctly sized by power quality measurements at the equipment Motor Control Center or at Transformer**
- **Watch for harmonics**



# *Other Monthly Charges*

**Fuel Cost Adjustment- usually in Rate or Rider**

- Passed through as allowed by utility commissions
- Natural gas yields credits from fuel switching

**Renewable Energy &/or Demand Side Management program charges- usually in Rate or Rider**

- May be opt out provision; check rate schedules
- Ask utility account manager

**Lighting: Area lights leased monthly by type and pole**

- Pole audit; only pay for poles on your property
- Are your poles metered (pay for kWh)? Change to LED

**Taxes**

- State, Municipal, Gross Receipts; Varies by State
- Based on meter location; check for exemptions

**Additional Facilities (do you know what this is for?)**

**Municipal Utility Bills may include all utilities; water, wastewater, waste management, telecom, etc.**



# *Large Utilities: Many Rates*

- Riders/Billing Adjustment (RE, EE & DSM programs)
- All Electric
- Churches
- Seasonal (sports lighting)
- Mining
- Real-Time Pricing
- Interruptible (Demand-side Management)
- Co-generation, Thermal Storage
- Renewable/Solar
- Experimental
- Economic Development
- Special Requests! Negotiate with utility
- **RATES CHANGE FREQUENTLY!**



# Interval Meter Data: Load Profile

How many Intervals in a month? 15 min. interval meter is most common

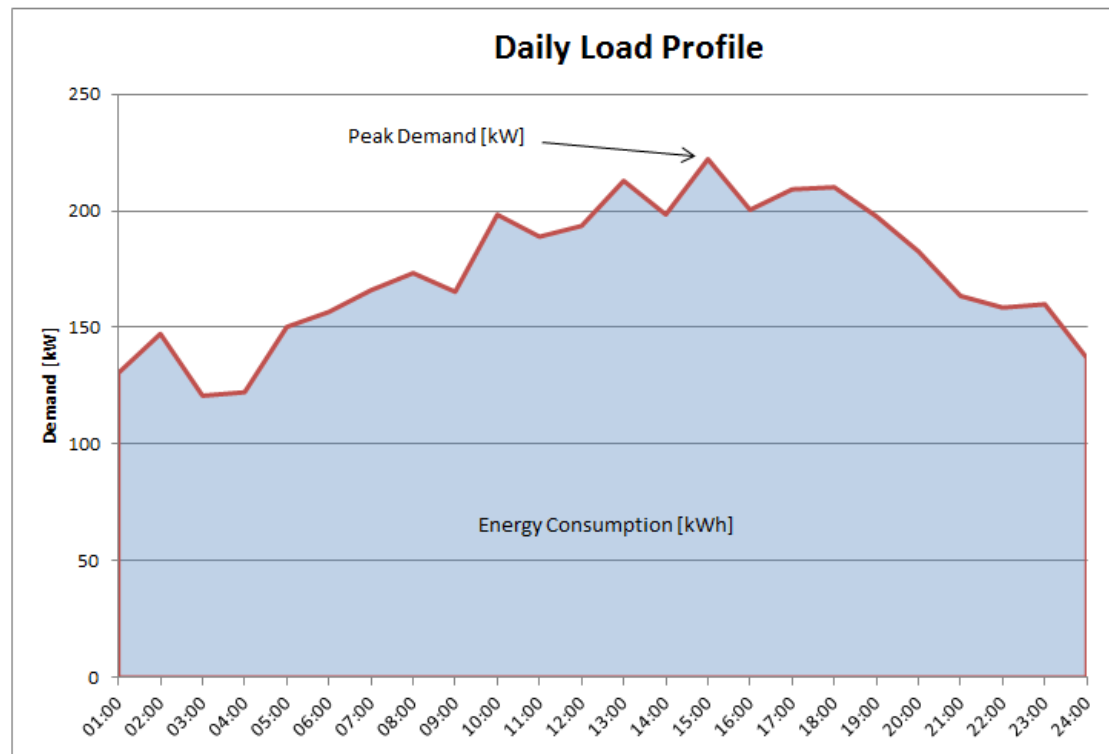
4 avg. kW/hour x 24 hours = 96 intervals/day

96 intervals x 30 days = **2,880** readings per mo.

*Graph it* = Demand Profile KW vs. Time

Utilities offer as fee service: monthly, daily, real time

May provide historical data annually at no cost



# *How to Estimate Energy Savings for Projects?*

1. Average cost per kWh for time period
  - Total cost/total kWh = avg. \$/kWh
  - Blended rate includes demand “savings”
  - Project may not impact demand
  - Not typically the most accurate
2. Billed cost savings per rate schedule
  - Project demand savings x kW rate
  - Project energy savings x kWh rate
  - Time of Use Rates? Operating time of day?
  - Parking lot lighting only at night
  - Include monthly facilities charges x 12 for total \$



# *Natural Gas*

## Units of billing and conversions:

- Therms (th) = 100,000 BTUs
- Dekatherm (dt) = 10 x therms = 1,000,000 BTUs
- CF = cubic feet = approx. 1000 BTUs
- CCF = 100 cubic feet = 1 therm
- BTU x Heat Rate Factor = therms
- BTUs British Thermal Unit
- 1 MMBTU = 1,000,000 BTUs

**LDC Local Distribution Company delivers gas to end-users**

**PSNC, Piedmont (bought by Duke Energy)**

**Metered in CF; converted to therms**

**Transport Gas = Pipeline Gas; for large users (see LDC rates)**

**less \$\$ than from LDC**

**State Contract with Texican**

**You may receive two bills, so don't double count units!**



# *Water-Sewer Bill Tips*

**Units of Consumption: May or may not be on the bill**

- Gallons, 1,000 gallons, CF, CCF, “units”
- Go to Utility Website: Municipal utilities

**Sewer charges usually same utility; don't double count usage!**

**Rates!**

- Sewer usually double water rate
- City Limits? Are you in or out? May be higher rates OS (outside!)
- Sewer deduct for water tower evaporation; add meter to makeup
- Sewer deduct for irrigation
- Fixed monthly fee based on meter size; can request smaller meters

**Monitor monthly bills:**

**Spikes = leaks, toilets running, broken line**

**Zero consumption? Broken meter or no usage**

**Request account to be closed, save on monthly fee**

**Stormwater fee = property tax?! Cost per sf impermeable area**

# *Lessons Learned*

## **Power Factor Penalty \$5,000 +**

- Installed 1000 KVAR Capacitor Banks \$\$\$
- No change to Power Factor Penalty
- Utility changed demand meter
- PF went from 0.62 to 0.85
- Reviewed daily demand meter data provided in spreadsheet from utility for 15 min. KW, KVAR
- Old PF meter programmed taking average every 15 min. instead of peak; very low PF at low loads at night

## **Power Factor Penalty for PF greater than 1**

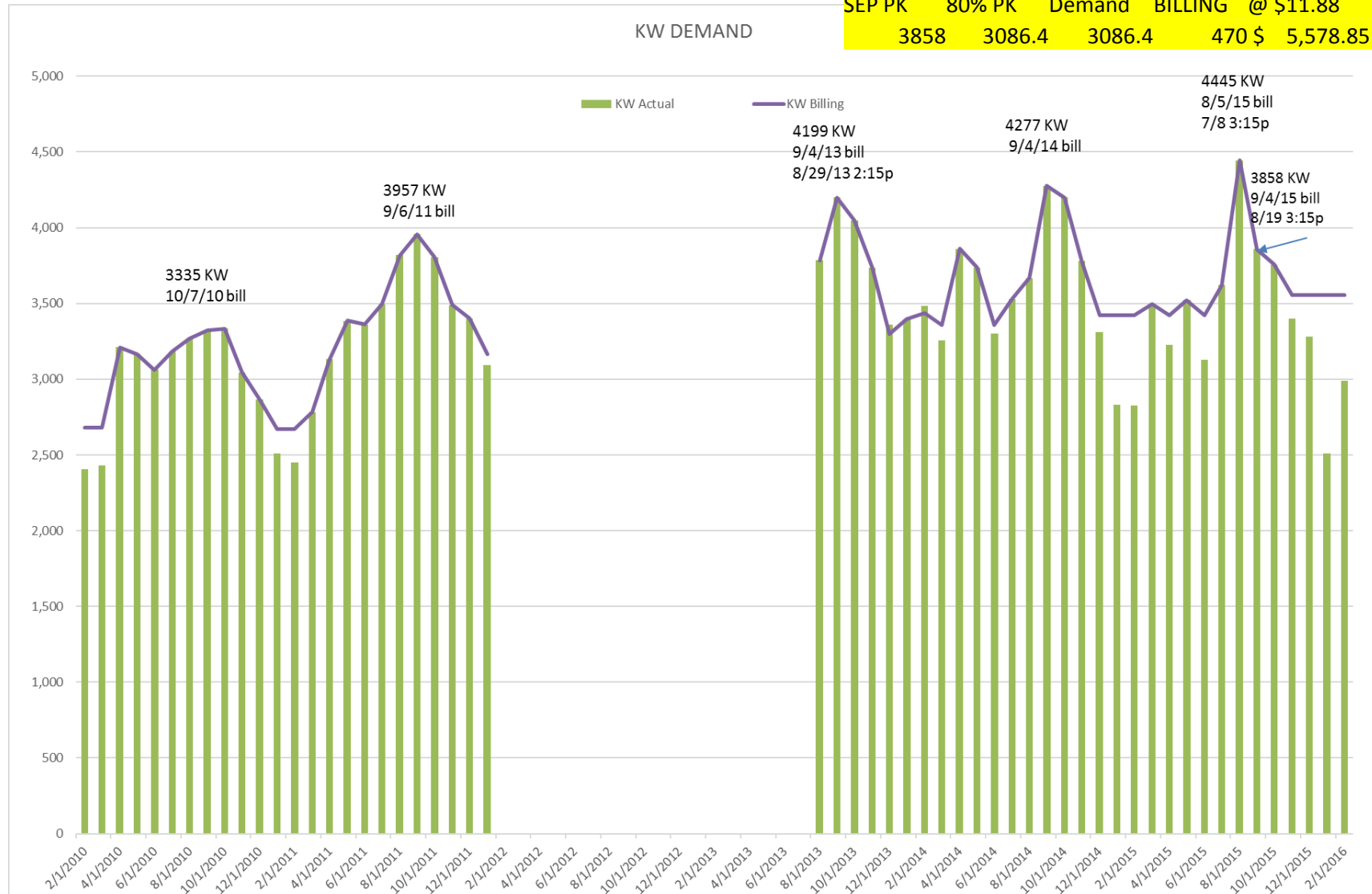
- approximately \$500 per month for years
- Utility Company installed PF correction on incoming distribution lines
- Capacitors oversized; loads changed?
- PF over-corrected to Leading PF (vs. Lagging)
- Customer unable to fix; requested assistance from utility





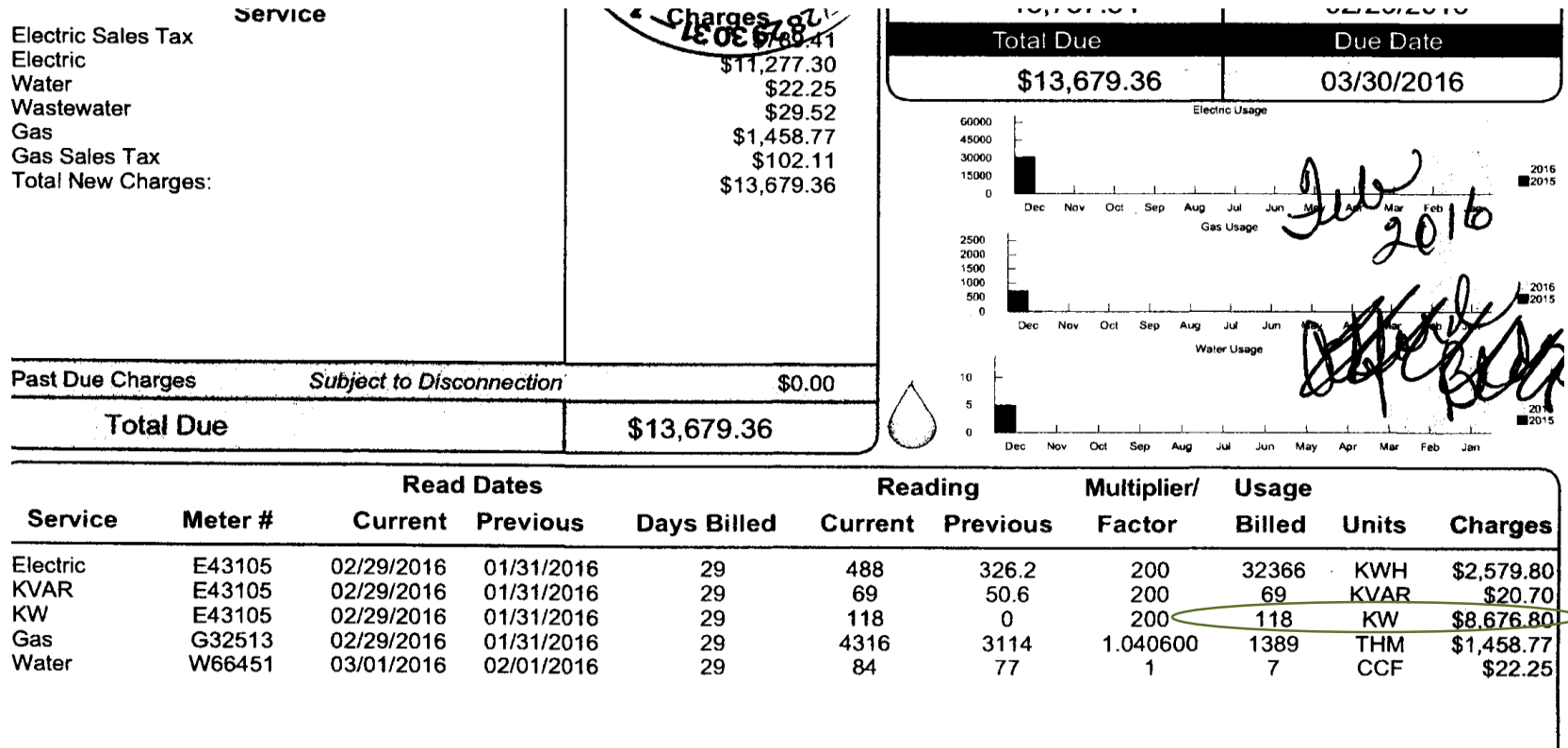
# Lessons Learned

	RATCHET	New Bill	DIFF
SEP PK	80% PK	Demand	Ratchets/ADDED COST BILLING @ \$11.88
3858	3086.4	3086.4	470 \$ 5,578.85



\$28,000 billing adjustment (refund) for broken equipment in July; reset peak to September (historical) and reduced ratchet and # months on ratchet

# Lessons Learned



- Large contract demand 638 KW, rate MGS signed March 2015
- Rate changed to LGS for transformer size > 500 kW September 2015
- Cost per kw \$11 to \$17
- Utility changed transformer; new bill for 200 kW = \$1,924



# *Lessons Learned Data Mgmt*

## **3<sup>rd</sup> Party Bill Management Services**

- Fixed fee per bill per month
- All billing data captured in database
- Bills routed to 3<sup>rd</sup> party
- Web-based reporting, graphs
- Bill Payment optional (can upload payment data)
- Exception reporting automated to spot errors, water leaks, controls issues
- Upload site data for KPIs (number students, widgets, prisoners)

**Manual tracking of billed data in spreadsheets time-consuming plus possible data entry errors**

**Do-it-yourself: Portfolio Manager is FREE DOE tool  
upload spreadsheets, weather normalization option,  
soon to include kW tracking**

**Packaged Energy Management software; some with data-entry options**

**“Enterprise” accounting software- IT added field for Units**



# *Steps to Succe\$\$*

- Read the bills; review all data and charges
- Meet with your Utility Account Manager
- Sign up for Utility websites for services, rates, tools, newsletters
- 1 to 2 year billing history by account; download or copy and paste
- Request rate reviews from utility annually
- Read the Rates and Tariffs for specifics on:
  - Demand kW tiers, Billing Demand, Ratchets,
  - Time-of-Use seasonal dates and times,
  - Power Factor calculations, Riders, etc.
- Request and read your utility contracts for service agreement, contract demand, voltage,
  - Transformer sizes, renewal and expiration dates
- Caught on Ratchet? Need to lower contract kW?
- Track the data and graph monthly to spot opportunities
- Typically 1-2% Savings from Utility Bill and Rate Reviews
- More savings with Demand Response programs!



*“If you don’t ask, you don’t get!”*

*Questions?*

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**THANK YOU!**